

Gas and Power Opportunities and Challenges

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Abstract

Gas use worldwide at 3.4% per year is being outpaced by growth in the Asian/Pacific Rim markets at 5.5% per year (on average) over the next 15 years.

Gas infrastructure growth potential, given New Zealand's resource base size, is promising. New Zealand ranks 35th in world gas production, but 60th in world oil production.

DRI forecasts New Zealand is to double its power plant capacity over the next 20 years. The economics of gas-fired power compared to coal-burning plants are shown, as well as environmental advantages. New Zealand, about the same size gas market as the United States state of Oregon, has 3.5 million people versus 3.0 million in Oregon. Changes in gas deregulation in the United States are discussed, which have created a variety of gas price and pipeline rate and service changes and where discounts are commonplace. This has fostered growth, efficiency, and more joint investments in pipeline expansion and new projects among producers, pipelines and end-use shippers alike.

Drivers of Change

Technology, global trade, and deregulation or privatization are driving the changes in the global energy business today. Technology is resulting in greater efficiency in finding and using energy and downstream the converging of energy and communications is also being led by advances in technology. Growing international trade, Internet communications, and environmental stewardship are all intensifying. The shift from public, to private ownership and replacing regulated prices and terms with commercial market practices are injecting change in many energy markets as competition replaces regulation.

Energy Mix

The 1997 Enron Energy Outlook forecasts the energy mix of the world comprised of 358 quadrillion Btus (quads) of which oil is the dominant share today. The world energy appetite grows to 564 quads by the year 2015 and while oil remains dominant, natural gas replaces coal as the number two ranked fuel. Gas use is forecast to double from 77 Tcf in 1996 to 147 Tcf by 2015. Renewables also double over the next 20 years.

Clean Fuels

By 2015, 36% of world energy will be from clean fuels. A 75% cost reduction in the installation of solar and wind in the last 10 years has promoted renewables growth.

Asia/Pacific Gas Reserves

Asia holds relatively more natural gas than oil, with 17 years of proved reserves life for oil compared to 45 years for natural gas. Asia's proved gas reserves are 363 Tcf. Current production is 8 Tcf a year of gas and 7 mmbd of oil.

Asia's Growth in Gas

Enron forecasts gas use in the region increases at an average of 5.5% per year versus the world pace of 3.4% between now and year 2015. New Zealand ranks thirty-

	TCF	BCM	vs	Billion bbls Proved Oil Reserves
Australia	20	566		1.8
China	59	1,671		24.0
India	25	708		4.3
Indonesia	69	1,954		4.9
Malaysia	80	2,266		3.9
New Zealand	3	84		0.1
P.N. Guinea	15	425		0.3
Thailand	6	170		0.3
Other Asia	86	2,433		2.7
Total	363	10,277		42.3

Table 1. Asia/Pacific Rim Proved Natural Gas. (Source: 1997 Enron Outlook and Oil & Gas Journal 1 January 1998.)

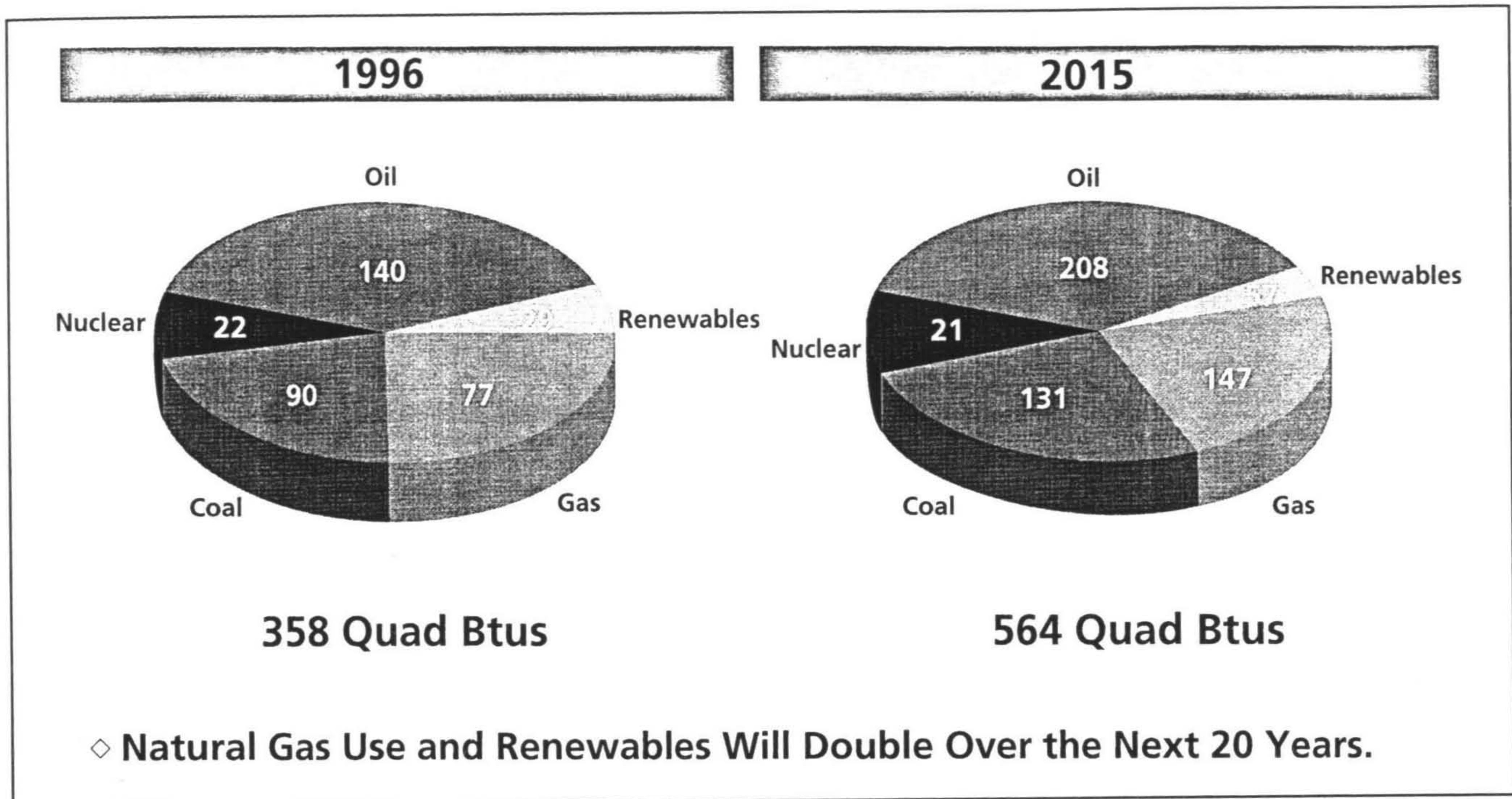


Figure 1. Changes in the world energy mix. (Source: 1997 Enron Outlook.)

	TCF	BCM
Australia	0.8	23
China	0.7	20
India	0.7	20
Indonesia	1.1	31
Japan	2.2	62
Malaysia	0.4	12
New Zealand	0.15	4
P.N. Guinea	NR	NR
Other Asia	<u>1.95</u>	<u>55</u>
Total	8.0	227

Table 2. Asia/Pacific Rim Gas Use 1996. (Source: 1997 Enron Outlook.)

fifth in world gas production, but sixtieth in oil. With a modest gas pipeline grid, there is a need for additional gas infrastructure in New Zealand. DRI McGraw-Hill forecasts by 2015 that New Zealand could double its electricity generation capacity – a prime opportunity for natural gas use.

GDP and Power

Enron's *Outlook* forecasts GDP growth in Asia to average 4.5% per year over the 1997-2015 time frame versus world growth at 3.3%. World electricity use growth is forecast to grow at 3.5% versus Asia at 4.5% per year by 2015. The *Outlook* had provided for two recessions in Asia's markets over the 1996-2015 time frame.

How Big are the World Gas Reserves?

World gas reserves were 2,540 Tcf in 1976, 3,481 Tcf in 1986, and 5,011 Tcf in 1996 - doubling in a time period

	1/1/76	1/1/86	1/1/96
Central & South America	85	112	214
Middle East	736	855	1,612
Africa	250	198	348
Asia	116	201	363
West & East Europe	201	226	169
North America	304	373	299
Russia/FSU	<u>848</u>	<u>1,516</u>	<u>2,006</u>
Total	2,540	3,481	5,011
Annual World Gas Production			
(TCF)	48	64	77
(BCM)	1,360	1,812	2,180
Reserves Life (in years)	53	54	65

Table 3. Proved Natural Gas Reserves in TCF. Today natural gas reserves have a 65-year production life. And the world's recoverable gas resource base has a 200-year supply. Source: US DOE, International Petroleum Encyclopedia and Government reports.

where demand grew about 50% from 48 Tcf to 77 Tcf by 1996. The world has a 65 year proved gas production life. The potential gas resources backing up the proved reserves are 200 years worth at today's use rates.

The leading growth areas for gas on a pure volume basis are North America (up 16 Tcf by 2015) and Asia (up 14 Tcf) over the same period.

In real terms, excluding effects of inflation, the world average wellhead price is forecast in 2015 to be \$1.47 MMbtu, with North America at \$1.89 and Rest of the World netback wellhead price at an average of at \$1.30 MMbtu in real terms.

	1996	2015	Increase
North America	26	42	16
Latin America	3	11	8
Western Europe	12	23	11
Russia/FSU/E. Europe	22	32	10
Africa	2	5	3
Middle East	4	12	8
Asia/Pacific Rim	8	22	14
Total	77	147	70

Table 4. World Natural Gas Demand Forecast - 2015 in Trillion Cubic Feet. By 2015, the North American natural gas market will grow by 16 tcf or 62% above 1996 levels. By 2015, the Asia/Pacific Rim area will grow by 14 Tcf or 175% above 1996 levels. Source: 1997 Enron Outlook.

Gas Netback Price Forecast

Enron calculated a world gas netback price for 1996 that in nominal dollars represents a North American average price of \$1.81 MMbtu versus the rest of the world at \$1.15 - for a 1996 world average in nominal dollars of \$1.37 MMbtu. By 2015, Enron forecasts the world average price increases to \$2.50 (nominal) with the United States at \$3.21 versus the rest of the world at \$2.28 MMbtu.

United States Pipeline Trends

Pipeline construction since 1929 has increased the mileage of the United States grid tenfold. Competition in gas pipeline rates has resulted in a variety of changes among major United States gas pipelines. Rate decreases since 1991 are more severe than increases. Although more pipelines increased than decreased rates due to competition in the United States since 1991, gas pipeline rates paid by shippers declined an average 15% (that is, from a 42 cents average to a 36 cents average).

Global Gas Pipelines to be Added

The world is estimated to need 335,000 miles of new gas pipelines by 2015, with North America, Europe, and Asia the three leading growth areas on a mileage basis.

New Power Plant Economics

Natural gas power plant capital costs are \$465-635 per kWh installed compared to coal plants at \$1,066-1,408. As gas plants have less downtime for maintenance, they can run at 95% rates. According to ICF-Kaiser, power from gas combined-cycle plants is estimated on a levelised basis at 2.75 cents per kWh to 4.91 cents per kWh versus coal at 4.16 to 5.16 cents per kWh.

LNG Trends

World LNG use is forecast to double by 2015, to 140 millions tons a year. Asia grows the most rapidly.

Enron Base Case	In \$/MMbtu	
In Nominal Dollars	1996	2015
North America	\$1.81	\$3.31
Rest of World	\$1.15	\$2.28
World Average Gas Netback Price	\$1.37	\$2.58
In Real 1996 Dollars		
North America	\$1.81	\$1.89
Rest of World	\$1.15	\$1.30
World Average Gas Netback Price	\$1.37	\$1.47

Table 5. The Forecast for Future Gas Netback Prices. Excluding effects of inflation. Assumes \$20.00 per barrel oil price (real) in base case.

	1995	2015
North America	384	432
Latin America	11	57
Western & East Europe/FSU	315	380
Middle East/Africa	16	77
Asia/Pacific Rim	54	169
Total World	780	1,115

Table 6. The Growth Opportunities for Natural Gas Pipelines in Thousand Miles. Natural gas pipelines will increase by 335,000 miles, or 45%.

Global Power Plant Opportunities

The world planned additions would increase global capacity from 3,037 gigawatts of capacity today to 4,404 gigawatts by the year 2015 - a 45% increase should all planned plants be built. This would be very optimistic, of course, but if just half this amount is added by 2015 (that is, about 650 GW installed of 1,367 GW added), this represents a \$715 billion capital cost by 2015.

Power Plant Fuel Trends

Enron forecasts power plant fuel use to grow 3.5% per year based on gas growth at 5.7% per year; coal and oil at 3.5% and 3.3%, respectively; and nuclear use off slightly, down 0.1% per year by 2015. Renewables are forecast to grow at the most rapid pace, that is 7.6% per year by 2015.

Environmental Advantage

Although renewables have no SO₂, NO_x, or CO₂ emissions, natural gas in power plants reduce SO₂ emissions by 100%; NO_x is reduced by 81%; and CO₂ is reduced by 58% versus coal plants. And gas plants have no ash, sludge, and 95% less particulates than coal.

Electricity Use Growth

World electricity use is forecast by Enron to grow 3.5% worldwide by 2015. This is at a pace of 4.5% per year in

markets like Asia, compared to 3.1% per year in the OECD. The world used 12,700 BkWh in 1995 and this rises to 25,270 BkWh by 2015 worldwide according to the *Enron Outlook*.

Privatisation Trends

From 1984-94, over \$468 billion in state-owned enterprises were sold to investors worldwide and another \$514 billion is planned to be sold in 68 countries. Yet, 25 of the 185 nations of the world are private market economies and another 43 are emerging. There is still a long way for privatisation to go.

Observations and Conclusions

Gas and renewables use doubles by 2015 as environmental concerns grow. Today, world gas reserves are twice as large as 20 years ago; Asia is three times more gas prone than oil based on reserves in place; Asia gas use and infrastructure are growing at faster than the world pace. World gas netback prices increase modestly in real terms over the 1997-2015 time frame. Gas and electric convergence, privatisation, and new assets promote efficiency and global economic development.

Author

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